Space Weather Technical Forecast

Issued on Wednesday 30 October 2024 at 13:07 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Occasional M-flares expected, with slight chance of X-class flares. S1 Minor Storm easing.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate with peak flare M1.1 at 29/1633 UTC from AR3869, however this occurred alongside a very long duration C-class flare due to a broad prominence and filament eruption off the southwest disc. There are now eleven sunspot containing active regions, with AR3863 fading from view on the west limb and AR3875 redeveloping in the northwest disk. The south-centre disc contains a cluster of three spots. AR3869 is the largest and most complex with its polarities in the reverse configuration to what would typically be expected for a SC25 southern hemisphere spot. AR3872 is a simpler open bipolar spot, but with a potentially unstable N-S orientation. AR3876, just to the northwest of this group, has seen its small spots coalesce, and has seen the weak delta spot on its northern proximity fade somewhat. AR3878 remains the most likely flare source, with the moderate strength delta spot on its trailer. AR3879 in the northeast is large and simple, but is likely the returning Ex-AR3848, which produced a notable eruptive X-flare on the previous rotation.

No Earth-directed CMEs were observed in available imagery.

Solar Wind / Geomagnetic Activity: Ongoing fast winds were observed, likely associated with CH85. Solar wind speeds, observed by ACE at L1, were slightly elevated to elevated, highly variable between 450-550 km/s. Density was below average. The Interplanetary Magnetic Field (IMF), Bt, was weak around 5-8nT, with the north-south component, Bz, varying weakly but favoring a negative (southward) orientation. Phi angle remained chiefly negative (towards the Sun). Resulting geomagnetic activity was Quiet to Active (Kp2-4).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 was at at S2 Moderate Radiation Storm to begin the period. This eased to S1 Minor Radiation Storm levels from 29/1455 UTC, and continued easing to be at 49pfu at 30/1200 UTC. High energy electron flux (greater than 2MeV) observed by GOES16 was at background. The associated 24-hour fluence was well below the Active threshold, with 2.01e6 integrated flux observed at 30/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Generally Moderate activity is expected to continue through the period, with occasional M-class flares expected and a persistent slight chance of an isolated X-class flare.

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Solar Wind / Geomagnetic Activity: There are no CME arrivals currently expected, although forecast is lower than usual confidence. Current fast winds expected to slowly ease towards background through days 1-2 (30-31 Oct). Mainly Quiet geomagnetic activity is expected, with occasional Unsettled intervals and a chance of Active intervals on day 1 (30 Oct). Activity is currently expected to remain generally Quiet to Unsettled thereafter.

Energetic Particles / Solar Radiation: The high energy proton flux at GOES-18 is currently at S1 Moderate Radiation Storm, but slowly declining, and likely falling below this level in the next 48 hours. However, any further notable flares will bring the potential for further enhancement. The high energy electron flux is expected to be mainly Background, with the associated fluence forecast to persist below Active.

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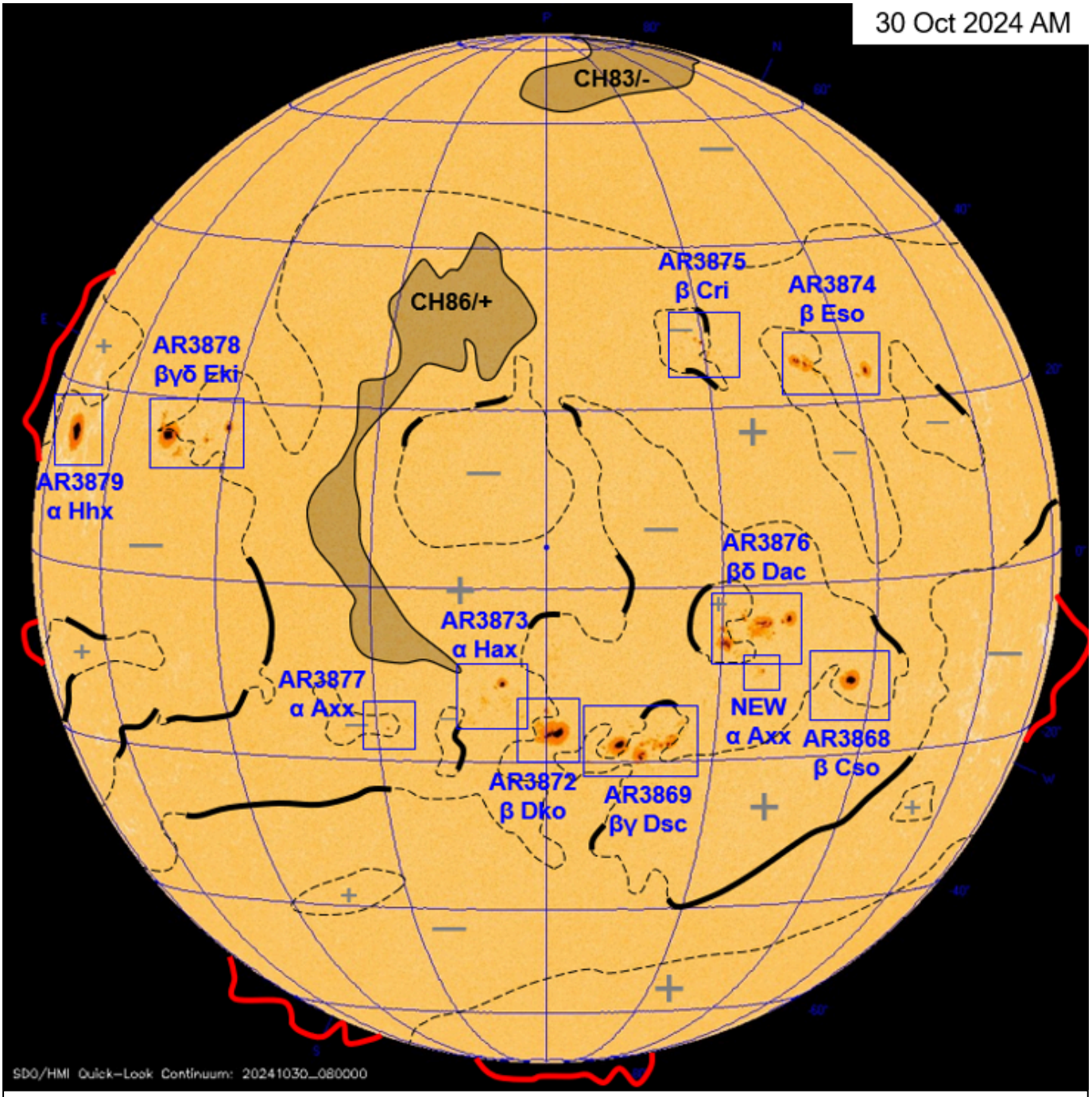
Figure 1: Solar Synoptic Map Valid 30/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

There are currently no Earth-directed CMEs expected. However, given recent imagery issues and the number of filaments on the Earth-facing disc, along with the continued chance for notable flares, this has the potential to change at short notice and is lower than usual confidence.

Current fast winds, most likely associated with CH85/-, are expected to slowly ease through days 1-2 (30-31 Oct) with speeds easing towards background levels. This gradual easing trend is supported by MOSWOC Enlil, although this maintains faster winds for longer than currently expected. No other enhancements are expected in the period, with the next coronal hole enhancement likely from the elongated CH86/+ which is currently in the eastern disc.

Mainly Quiet geomagnetic activity is expected, with occasional Unsettled intervals and a chance of Active intervals on day 1 (30 Oct). Activity is currently expected to remain generally Quiet to Unsettled thereafter, but with an increasing slight chance of Active to G1/G2 conditions into the period given the lower than usual CME forecast mentioned above.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	1	5	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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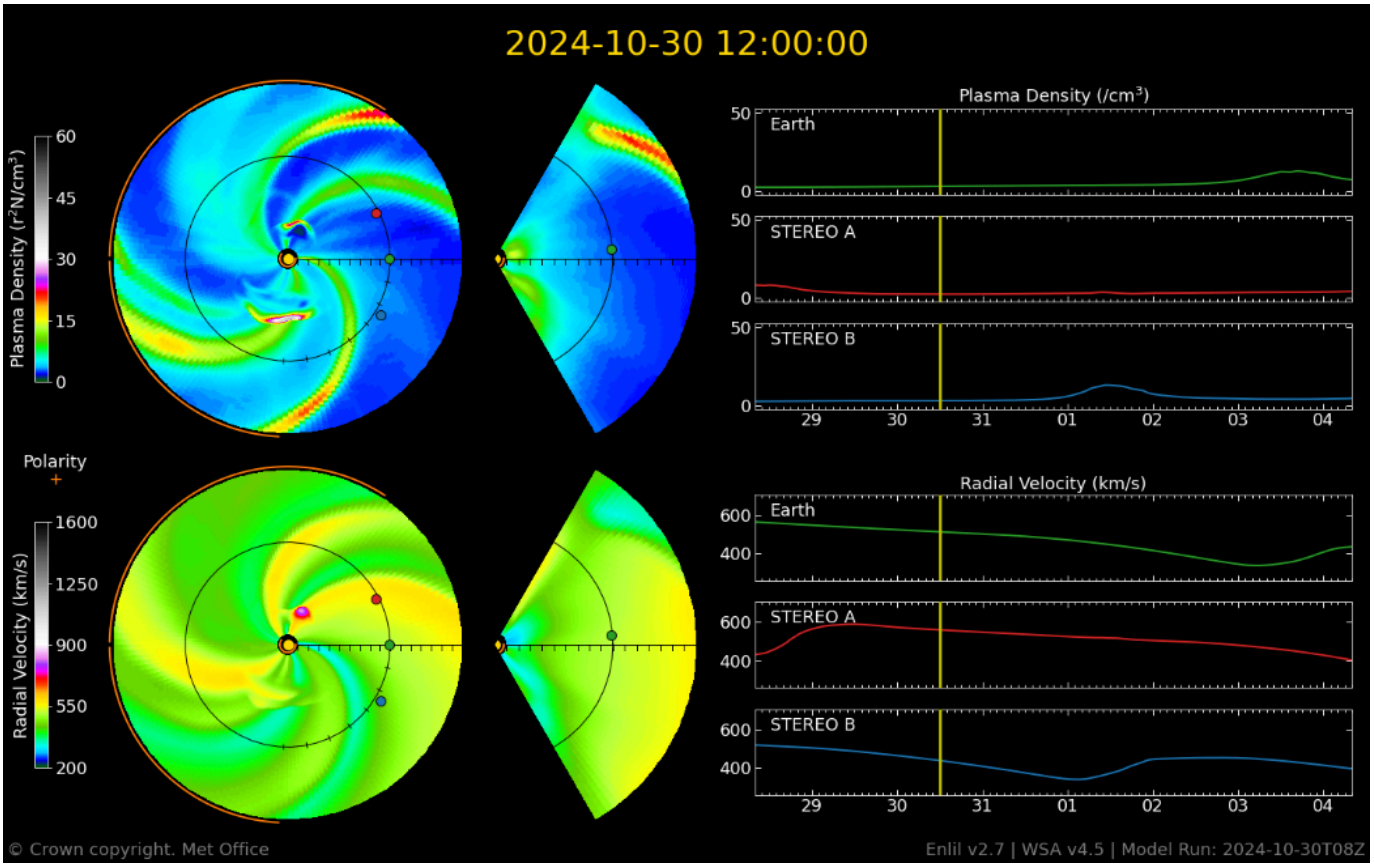
Figure 2: Latest MOSWOC ENLIL output.



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Radio Blackouts - X-Ray Flares

Generally Moderate activity is expected to continue through the period, with occasional M-class flares expected and a persistent slight chance of an isolated X-class flare.

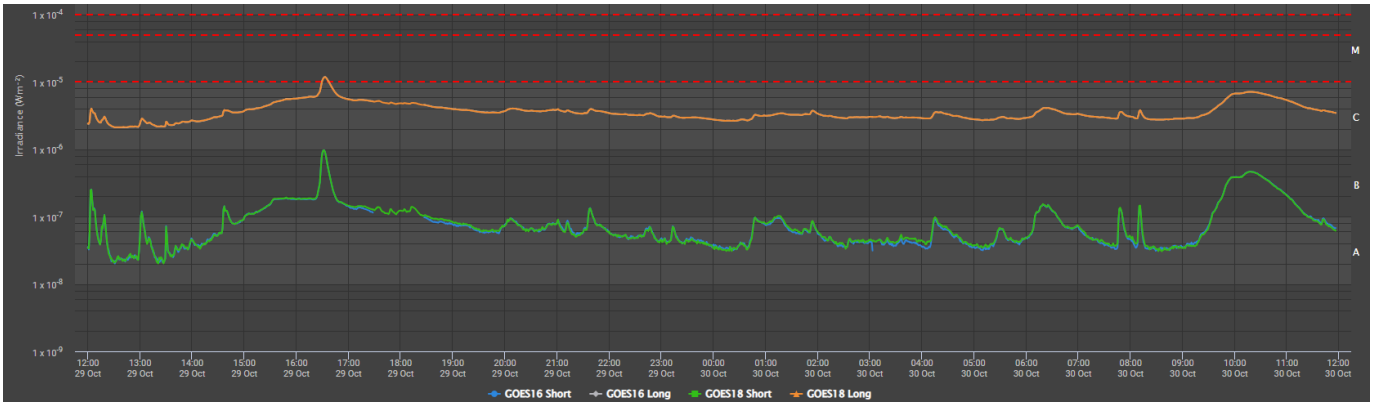
The most frequent flaring region currently is AR3878 in the northeast. This region maintains a moderately strong delta spot on its trailer, bright in SDO aia-imagery, suggesting further activity is likely. The cluster of three spots in the south-centre disc have shown a general declining trend, but continue to provide a potential for further notable flares. The most significant of these is now AR3869, having been reanalysed to include the previous leader of AR3872, due to its proximity and apparent structure in SDO aia-imagery. This results in an anti-Hale cycle spot, with some mixed polarity among the small leader spots. AR3872 continues to be a bipolar region, but now a simpler north-south aligned spot, while AR3873 is now a declining unipolar spot

Also of interest is AR3876 to the northwest of the cluster. This has seen its spots coalesce into three main larger spots, but with a small spot to the north of its intermediate showing a potential very weak delta configuration. AR3874 in the northwest is a simple bipolar group, while a yet to be numbered region in the northeast appears to be a large unipolar spot, but is potentially the returning region that produce the notable eruptive event on 09 Oct.

No other significant returning regions are signaled via recurrence or far-side sounding data, with the bulk of significant regions remaining on the visible disk through the period. Therefore the flare risk is maintained steady throughout the forecast period pending further developments.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	70	70	70	70
Very Active	R3-R5 (X Class)	No	20	20	20	20

Figure 3: Latest 24hr GOES16/18 X-ray Flux Trace.



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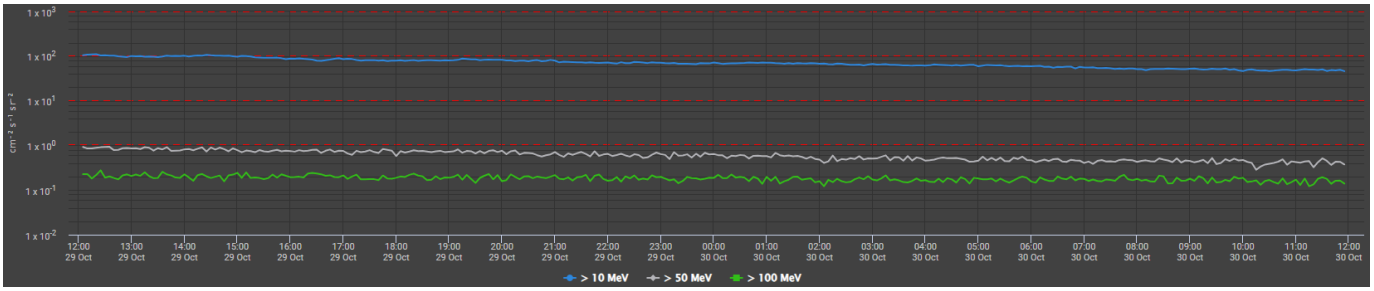
Solar Radiation Storms (High Energy Protons)

Recent CME and X-flare activity elevated the high energy proton flux at GOES-18 over the previous day, which after peaking at S2 Moderate Radiation Storm, is now easing to be at S1 Minor Radiation Storm level at time of issue. A gradual decay is now expected, likely falling below S1 during the coming 48 hours.

Further enhancements remain possible however, with the potential for notable flares from a number of the sunspots on the disc. This includes the cluster of regions in the south-centre disc, plus AR3876 to the northwest of this cluster. Notable flares are also possible from AR3878 in the northeast, and while less likely produce observable protons at Earth, this cannot be ruled out.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	Yes	99	80	40	20
Very Active	**≥ S3 ***	No	5	5	5	5
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: Latest 24hr GOES18 Proton Flux Trace.



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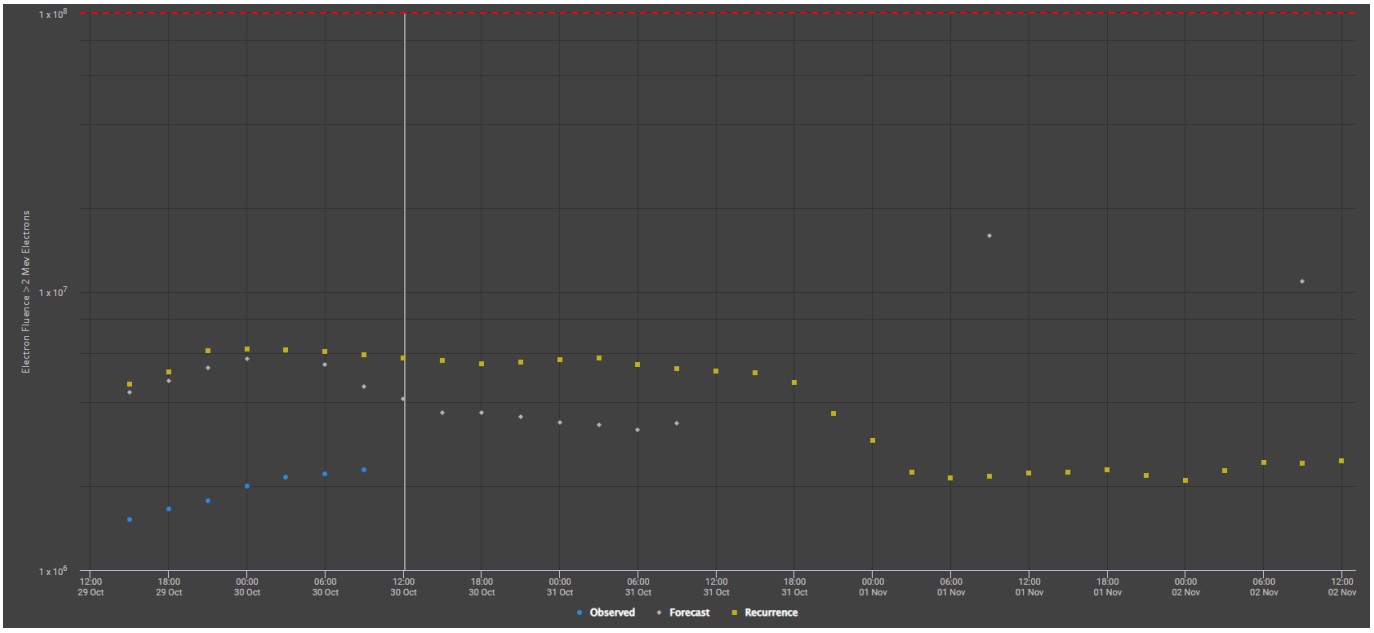
High Energy Electrons (≥ 2MeV)

High energy electron flux (greater than 2MeV) as observed by GOES16 is currently at background and expected to persist mostly at this level, with only brief spells of moderate enhancement expected.

The associated 24-hour fluence is currently expected to remain well below Active throughout the period, with the MOSWOC REFM forecast though to be providing reasonable guidance to staying below this Active level, although this is likely to over-estimate the forecast fluence due to the current elevated winds.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	1	1
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 5: Latest MOSWOC REFM model output.



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